ATTACHMENT 3.0

BLACK RANGE
MINERALS

Lab Test Results and Discussion

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Lab Test Results and Discussion

This attachment is provided to respond to the Colorado Department of Public Health and Environment's (CDPHE) letter to Black Range Minerals of 13 August 2016 in which the CDPHE requested that Black Range Minerals provide:

3. If available, please provide sample lab test results showing the mineral, physical, and chemical compositions of uranium and its progeny and any other major metals for the pre-AMT sandstone, post-AMT minerals, and the post-AMT waste rocks.

Table 1 provides data from the October Reclamation Stockpile material and analyses for uranium and thorium (Total Metals) and a Total Radionuclides analyses. The Pre AMT ROM was a split of a mass of October Reclamation Stockpile material which was introduced to the pilot ablation system. The post AMT ore sample was obtained via collecting a split of post AMT, screened to -400 mesh, dewatered October Ore Pile Reclamation Mine material. The post AMT waste sample was obtained by collecting a split of each of the five size fractions created from screening and drying post AMT slurry.

Additionally, lab sheets are attached in Attachment 2.4 of this submittal package which include: total radionuclides and total metals for 1) pre AMT ROM 2) post AMT coarse waste, and 3) post AMT ore product; uranium and vanadium metal analyses for five (5) size fractions of the post AMT coarse waste; and SPLP analyses for 1) pre AMT ROM and 2) post AMT coarse waste.

Table 1: Pre and Post AMT Material – Uranium, Thorium, and Radionuclide Analyses

	ROM (pre AMT material)	-400 (post AMT ore)	Clean Sand (post AMT waste)	
Metals - Total	**Result (mg/Kg)**	**Result (mg/Kg)**	**Result (mg/Kg)**	**method**
Uranium	1350	4590	110	6010c
Thorium	ND	ND	ND	6010c
Radionuclides - Total	**Result (pCi/g)**	**Result (pCi/g)**	**Result (pCi/g)**	**method**
Lead 210	231	809	18.9	OTW01
Lead 210 Precision (+/-)	3.9	7.2	1.2	OTW01
Polonium 210	33.0	215	12.9	OTW01
Polonium 210 Precision (+/-)	2.7	10	2.6	OTW01
Radium 226	250	1200	29.1	E901.1 Mod.
Radium 226 Precision (+/-)	4.0	12	1.3	E901.1 Mod.
Radium 228	1.2	ND	ND	E901.1 Mod.
Radium 228 Precision (+/-)	1.0	NA	NA	E901.1 Mod.
Thorium 230	363.0	1610	34.8	ACW10
Thorium 230 Precision	36.0	177	3.8	ACW10

(+/-)				
Uranium 234	ND	830	ND	ACW01-Mod
Uranium 234 Precision (+/-)	ND	216	ND	ACW01-Mod
Uranium 235	ND	432	ND	ACW01-Mod
Uranium 235 Precision (+/-)	ND	113	ND	ACW01-Mod
Uranium 238	ND	938	ND	ACW01-Mod
Uranium 238 Precision (+/-)	ND	244	ND	ACW01-Mod

Proof That Secular Equilibrium is Preserved in the Post AMT Material (from SHB Inc.)

For pre AMT material:

Specific Activity of U 238 = 0.33 uCi U 238/g Unat * = 3.3 E5 pCi U 238/g Unat = 330 pCi U 238 / mg Unat

1350 mg Unat / kg rock = 330 pCi U 238 / mg Unat X 1350 mg Unat = 445 pCi U 238 / g rock vs. 363 pCi Th230 / g rock and 250 pCi Ra 226 / g rock

Accordingly, within uncertainty of measurement and potential geochemical effects in situ, approximate equilibrium is demonstrated. Also note that it is not unusual in “ore samples” that had been removed from their in situ environment and exposed to atmospheric conditions, that Pb 210 values can be depressed relative to the expected equilibrium condition. This is usually the result of the loss of Rn 222 gas from the sample which decreases the amount of progeny post Rn 222 at the end of the U 238 decay chain.

For Post AMT Material:

From above: 1 mg Unat = 330 pCi U 238

4590 mg Unat / kg rock X 330 pCi U 238 / mg Unat = 1514 pCi U 238 / g rock

Again, within uncertainty of measurement and potential geochemical effects in situ, 1610 pCi/g Th 230 and 1200 pCi/g Ra 226 demonstrates approximate equilibrium in the post AMT ore

* See:

Table 2-1, US Department of Energy. Guide of Good Practices for Occupational Radiological Protection In Uranium Facilities. DOE-STD-1136-2009 July 2009

US Nuclear Regulatory Commission 10 CFR 20, Standards for Protection Against Radiation, Appendix B, Footnote 3